PROPOSAL FOR AN

INSTITUTE OF INFORMATION SCIENCES

1. NEED

The major business of the United States government
is providing information. It gathers, analyzes and provides
information both for its own decision making bodies, such
as Congress, the President, the Department of Defense, and
for the public in general. Important examples of this
information processing in the government are: the military
intelligence community, the Patent Office, the Weather
Bureau, the military material control agencies, the activi-
ties of congressional investigating committees, etc.

The government also provides the public with a
great deal of information and data analysis typified by
the work of the Census Bureau, the Weather Bureau, NASA, the
Library of Congress, etc. Furthermore, one of the problems
now facing all of American industry, and nonprofit organi-
zations, as well as government agencies is the organization
and implementation of information systems. It appears that
the government must be in a position to provide national
assistance in this key area.

The need for improved information systems has been
made critical in recent years by the growth of the size and

complexity of all organizations. It appears that this nation
will continue to see the growth of both government and indus-
trial organizations and, in particular, organizations which
assume positions of great power within the national scene.
It is imperative that we learn how to manage such large
organizations effectively and yet without compromising basic
democratic principles. If this is not done, our current
institutions may well topple of their own weight and
inefficiencies.

The information problem is national, affecting
all the sectors of U.S. life, both private and governmental.
More than any other factor, the concept of voluminous alpha-
betical data outpouring from our printing presses and the
consequent inability on the part of researchers to find much
of it again after it appears in print is the prime mover
behind major information storage and retrieval efforts.
Mere volume alone, however, does not itself justify new
approaches. It is the combination of volume with fragmenta-
tion and multiple utilization of information which really
creates the problem. As the amount of information relevant
to decision making increases, the processes of obtaining,
examining and selecting the information required for a
particular decision becomes a very large task. In many
instances, the size of these tasks has become greater than
that which previous techniques could handle. Equally

important is the awareness that modern data processing
systems show promise of offering a solution. The prospect
of improving our capability in information storage and
retrieval through the nonnumerical use of computers is
comparable to that given to the scientist in his solution
of computational problems or to the businessman in the
solution of his data processing problems.

In spite of the fact that information processing
is a key government function, the government has no group
specifically charged with the responsibility of investiga-
ting methods of improving information systems; neither
research facilities nor consultants are available to
operating government agencies. As a result, there is a high
degree of inefficiency, of duplication of system design
effort, and a misuse of funds throughout the government as
each agency attempts to solve its own information system problems
with insignificant knowledge and too little coordination with
other agencies.

2. SOLUTION

This need can be fulfilled by the creation of an
Institute of Information Sciences as a nonprofit organiza-
tion supported by the government. This organization would
have three major functions: (1) to perform basic research
in information system design, information retrieval, data

processing and related areas, (2) to provide unbiased techni-
cal services and consultation to government agencies for
engineering specific information systems, and (3) to provide
for professional education in this field.

3. DISCUSSION

3.1 Examples of the Need

The following are some examples, briefly described,
of difficult situations which arise because of inadequate or
poorly designed information systems:

 1. The inability of federal personnel to make
optimum use of information available to them for
decision making.

 2. The inability of intelligence community to
process and analyze all of the data available to it.

 3. The inability of government logistics agencies
to maintain inventories at efficient levels.

 4. The high cost of correlating evidence in
complex (e.g., antitrust) legal actions.

 5. The difficulty in finding pertinent precedents
and applicable laws for legal review or action.

 6. Duplication of technical design efforts
because of the inability of documentation systems
to disseminate technical information throughout
the government and industry.

7. The high cost of operating many of the government agencies such as the Veterans Administration, Bureau of Internal Revenue.

8. The difficulty which the government, and in particular the military, has in finding people of proper skills to match specific jobs.

9. Various specific technical problems such as air traffic control, weather prediction, etc.

Although all of these areas have peculiar difficulties, most of the problems are general information system problems which can be solved when we have a better understanding of how to design efficient information systems using the data processing tools now available.

3.2 Background to the Solution

3.2.1 Philosophy

This proposal is based on the following philosophical tenets:

1. Information is an entity as important as energy, time, space or matter. A good information system is as vital to an organization as its financing, its personnel, its facilities, etc. Therefore, it is legitimate to specifically study information systems; their organization and design.

2. Information is the communication of ideas. As such it is the life blood of all human activity. Without

information, no organization can function. With an insuffi-
cient flow of information, any organization will falter
and is likely to make serious errors.

3. Top caliber people are required to make progress
in the field of information systems and further, must be
drawn from many existing disciplines such as:

Social Sciences	Engineering
Psychology	Electronics
Sociology	Computer
Economics	Programming
Math. Sciences	Others
Mathematics	Neurology
Logic	Librarianship
Operations Research	Linguistics

plus overall systems design.

4. Information Science may someday be a profession
in its own right although it is not recognized as such at
present. The aim of an Institute of Information Sciences
would be to bring together an interdisciplinary core of
skills to work on the problem and to train and educate
young professionals entering the field.

5. Regardless of the activity of the using
organization, all data processing or information systems
have many points in common and therefore it is worthwhile
studying the general theory of information systems, just as

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it is worthwhile styding a general theory of aerodynamics.
For example, all data processing systems have files, required
posting to these files, deal with exceptional cases and
summarize and analyze data for decision making.

6. Indeed, although Information Science is still
in its infancy, pioneers in the field have already estab-
lished one incontrovertible fact: No communications
systems or data processing machines exist which are adequate
to meet the information problem. They must be invented. It
is known that the Russians have recently recognized that
fact and are beginning to invest research and development
funds for such systems and devices. The key problem in
information system design is to achieve a balanced closed-
loop among three main areas -- the needs of the user, the
capability of equipment, and the dynamics of the system.

3.2.2 Nature of Information Systems

If one examines actual information systems, it
becomes evident that there are a number of ways of cate-
gorizing them. Figure 1 illustrates this specifically for
technical documentation systems. Even within this type of
information system we have a large number of users as shown
on the top of the box. Every one of these users has a
series of functions to perform, such as those along the
face of the box.   It is because
each user has all of these functions to perform that general
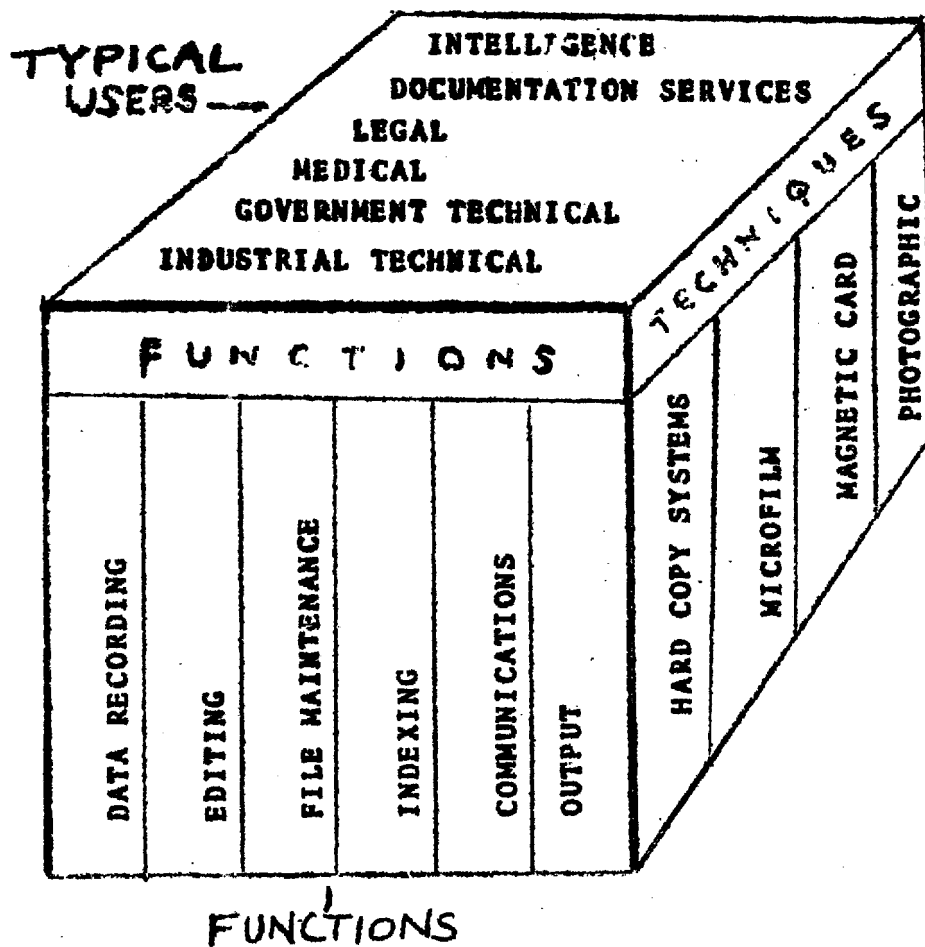
INTERACTIONS IN INFORMATION SYSTEMS

(BASED ON TECHNICAL DATA SYSTEMS)

FIGURE 1

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theories of information processing can be developed. Finally, there are a number of tools or techniques which the users can utilize to perform these functions. Some of these are listed along the side of the box.

The point of this figure (1) is that it is not sufficient to study one function, such as indexing methods, since the choice of a method of performing one function (and a choice of a technique for executing it) is directly dependent upon the choices for the other functions. The information system must be viewed as a whole. It is not sufficient furthermore to study a design using one technique. Conclusions drawn for magnetic tape techniques may be quite different from those to be drawn for hard copy systems. As a matter of fact, one key information systems design approach is to choose the proper techniques after the requirements and functional procedures are properly defined. To study a specific technique first leads to inefficient systems. In conclusion, a user then must study his entire problem and this is often easier to do with objective advice from outside of the user's group. Furthermore, since information systems do have common principles, it is possible for an institute to stand outside of this entire "box" and study information systems in general. This will lead to specific procedures and techniques for (1) determining basic

requirements, (2) defining functions and procedures, and (3) selecting the proper techniques to best satisfy a specific user's needs.

3.2.3 Personnel

At the present time the key contributors to the field of information systems (even those already working on the government's problems) are scattered throughout the nation in a variety of organizations. It is necessary to attract at least some of these top people together in an environment where they will be encouraged to devote full attention to the theoretical advancement of the field. These people are, for the most part, compelled to spend most of their time on applied research, are usually constrained by limited approaches imposed by a firm's policies (e.g., concerning necessary specialization in one type of product or raw material), and are prevented from communicating fully with fellow-experts because of commercial secrecy and also because of geographical separation from one another. It is, therefore, vital that an institute be established which can attract such top people.

3.2.4 Facilities

Although much information systems research can be done by paper and pencil, a large data processing "Laboratory"

is usually a vital tool. However, regardless of the location
of the institute there will undoubtedly be major computer
facilities available at universities or government agencies
nearby which can be made available. An institute can
therefore start with modest facilities of its own.

3.2.5 Organizational Level

In order to perform realistic research, and also
to provide useful consultation help, it is necessary for
the technical people to have access, through top manage-
ment, to the various agencies with the information problems.
In the government this means the Executive level. It is
obvious that consultants called in directly by a particular
agency are constrained by the "political" restrictions
imposed by that agency, and also are not permitted to per-
form research or development because of budget limita-
tions. A consultant entering the scene with top level
authority, however, is free to make a realistic and basic
examination of the problem and propose solutions which
will be effective whether or not they affect a particular
group's organization.

3.2.6 Possible Approaches

We have implied that there are various ways in
which the necessary research and development of information
systems can be done. These are reviewed and evaluated
briefly here.

(1) <u>Each organization does its own design.</u> This
approach is the one now in use and has the disadvantage
that it is extremely wasteful of money and, more important,
of key talent. It also prevents a good job from being done
in many cases because a solution to the information system
problem requires organizational changes which a given agency
cannot initiate as a result of self study, but can effect
if the recommendation comes from an authoritative outside
source.

(2) <u>Industry provides help.</u> It is true that
industry is active in research on information systems and
will, of course, provide much consulting help. However,
this help will always be slanted towards the desire of
industry to do the thing which is most profitable - namely
sell equipment. It is, therefore, difficult for the government
to get good unbiased help from industry. It is also true
that industrial research will be slanted towards the solu-
tions of industrial problems since industry provides the
most profitable market for most companies.

(3) <u>Universities provide help.</u> It would be
possible to delegate the research and consultation to
universities. Here, however, there are some drawbacks.
The universities tend to concentrate on the most advanced
and basic research. This is certainly important and should
be encouraged, but often does not solve the problems of the

near future and immediate periods. Also, in many universi-
ties the best people can't give full time to research
because of teaching and administrative duties. Further-
more, the problems of gaining understanding and of designing
information systems are so great and so important to the
government and to the country that a central institute is
required to supplement university research. Finally, there
is some question as to whether the universities can really
attract top people in face of the salary competition provi-
ded by industry. A special institute can, of course,
overcome this difficulty.

      (4) Special Institutes. There are three types of
institutes that could be proposed; private, government
sponsored and a government agency. The last appears to
be infeasible, because it would come under civil service
regulations which would practically preclude attracting
good people. Also a government agency would cause other
government organizations, who require consulting services,
to feel that the agency had some political "axe-to-grind."
A private institute would be possible except that none has
come into existence and there may be no justification for
it since industry and the universities each are proceeding
along their own paths in this area. A private institute
could not be asked to give priority to government problems.
Finally, there is the solution proposed here -- a nonprofit,
government sponsored institute.

3.3 Conclusion

With this background it appears evident that the most effective solution to this basic need on the part of government and the country is to form a nonprofit government Institute of Information Sciences. The remaining part of this paper goes into some details of how it might be organized.

4. PLAN FOR IMPLEMENTATION OF AN INSTITUTE OF INFORMATION SCIENCES

4.1 General

It is proposed that the Institute be an organization of limited size, perhaps fifty with a build-up to one hundred professional people, in order to promote a close, informal interchange of ideas. The institute would be located so that all necessary people and facilities are together in one building.

4.2 Organization

The general direction and policy of the Institute would be given by a select board of directors. These people, from the government and industry and the academic world, would insure that the institute maintained its objectivity and proper direction in research and consulting.

4.3 Director

The most important decision in establishing the
Institute is to select the most excellent director possible.
The director must have demonstrated great interest in
information sciences as well as have many years at exper-
ience in the field. He should have, in particular, demon-
strated ability to motivate and direct research people. Less
important, but desirable, would be a person who also had a
national reputation.

4.4 Operation

Several particular operational concepts are parti-
cularly pertinent.

(1) <u>Association with a university</u>. There may be
some value in placing the Institute of Information Sciences
on a university campus in order to develop an academic
atmosphere, to enhance its professional standing and to
provide an interchange between the university people and
the institute people. Although the institute may be
associated with the university, it should be free from
control of the university.

(2) <u>Professional recognition</u>. It is vital that
the institute have, as a basic principle, the prompt and
widespread recognition of contributions made by its indivi-
dual members (and by others in the information sciences
profession). In order to attract and retain high caliber

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personnel, it is necessary to provide them with a high level
of professional status. This can be attained, in part, by
the proper "image" for the institute, but is particularly
enhanced by policies which give specific professional
recognition to contributing individuals. This may be done
through awards, through financial aids, by holding confer-
ences and symposia at which papers are given by the staff,
through a wide dissemination of technical papers prepared
by the staff and through general public recognition.

(3) Laboratories. In its research projects the
institute should be encouraged to develop a "laboratory"
concept. One of the weaknesses of current information
systems studies is that nowhere in this country is there
an information system which is not operational but devoted
strictly to laboratory research. Because of this, all
studies have to be either theoretical or based on measure-
ments made on actual situations in which it is impossible
to isolate variables. For example, a complete technical
documentation library (perhaps on computer magnetic tape)
should be developed and used by the staff, not as their
principal library but as a laboratory for studying all of
the problems of data gathering, indexing, abstracting,
mechanical and man-machine communication in such a problem
area.

(4) <u>Rate of Progress</u>. With a small professional group it cannot be expected that the institute will solve all of the government's information system problems immediately. As a goal, the institute, in its consulting activities, might aim to design one major information system problem every year or two. It might start, for example, on problems in the technical documentation area, perhaps specifically in the engineering data problem of the military. If one such area was attacked per year (with perhaps three projects going at any one time), the institute ought to be able to assist the government in improving its key informa- tion systems during the next 5 or 10 year period.

(5) <u>Definition of Research</u>. It is worth making a clear distinction between consulting engineering and research. The institute, of course, must not get into the business of developing equipment systems or even related applications engineering. It should be principally a research organization. By research is meant projects which are theoretical in nature; this is, studies are not of a particular group's problem but are of an abstracted version of a problem which faces a number of organizations. Further, the research should be carried on without critical time pressures and schedules. We have indicated that the institute should undertake certain specific consulting

duties. This has two purposes. In the first place it
provides a vital need of the government. It permits high
caliber talent to be applied to critical information problems.
Of course, the implementation of the programs would be
carried out by the agencies themselves. Secondly, by
providing an active consulting role, the researchers would
have an opportunity to observe actual situations and could
both test ideas which they have developed and also keep
their theoretical work from deviating too far from reality.
For the development of programming systems, equipment
systems and hardware techniques, for component research
and for detailed applications engineering the institute
would depend on either an agency's own people or on
industrial contractors.

4.5 Initial Projects

In view of the current problems in the country
and the general situation in the state of the art at the
present time, it is recommended that the following programs
be undertaken initially.

One initial consulting project should be the
design of prototype and operational systems for the
gathering, storage and retrieval of technical data. This
is a vital need in the country to eliminate costly unrecog-
nized duplication and improve designers ability by aiding

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in correlating ideas. This would apply to key technical
fields including the missile field, the computer field,
the field of automation, medicine and so on. Furthermore,
the solution of the technical data retrieval problem will
provide a basis for solutions to other information and
retrieval problems in particular, that of the intelligence
community.

One part of the institute should be devoted to
providing facilities and support for individual research.
Carefully chosen creative people would be permitted to
carry on studies and experiments in whatever direction
they felt appropriate within the general boundaries of
information systems. This is an important research invest-
ment with a high probability of a major payoff over a
period of years.

In the area of research projects there are two
general types: one is research to improve methods of
decision making, including war gaming techniques; and the
second would be investigations into improved information
retrieval techniques. It is felt that work should begin
first in the information retrieval area for three reasons;
first, to support the technical data retrieval project;
second, it is an important problem throughout the country.
Indeed, one can show that every information system consists

basically of a data retrieval system and a decision maker
so that solutions to the retrieval problem will improve the
efficiency of many activities. It is probable that research
in decision making is proceeding at other places and need
not be covered immediately at the institute.

In view of the large number of government agencies
which now must make decisions as to the acquisition of
computers, the installation of new data processing systems,
and other problems related to information retrieval, it is
recommended that the institute begin an active program of
education. This would be at two levels: short, but not
trivial, courses for management personnel to permit them
to make better decisions in regard to their own information
system, and a longer term, intensive education program
for the technical people throughout the government who are
required to do the detailed work of information system
design.

5. EXAMPLES OF BENEFITS POSSIBLE

In summary, some of the benefits from the Institute
of Information Sciences will be these:

1. The Institute would emphasize the development
of solutions to technical problems which exist
today and which result from the evolution of modern
society and its needs, from population growth, from

political and economic development, and from the
exponential growth in the rate of output of the
recorded knowledge upon which our civilization
depends. The problems of storing, communicating
and utilizing information permeates our current
life and these problems are apt to become more
and more intense as time goes on.

2. The institute would serve as an impartial
member of what is now a highly competitive,
commercial field. It would benefit both govern-
ment agencies and commercial and nonprofit firms
by providing a source of impartial consultation,
by assisting in the establishment of standards
and by promoting the interchange of ideas.

3. It could recruit the best minds without civil
service constraints. There are many persons of
high technical ability and with keen interest in
this particular field who will welcome the
opportunity to leave more narrowly oriented
organizations and join colleagues from other
disciplines who are similarly enthused about the
information sciences. The character of information
problems is such that it cuts across the depart-
mental and agency lines and for this reason it
is more beneficial and economical for the govern-
ment to establish an independent organization

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rather than to attempt to do the job piecemeal.

4. The government does not now have technically
trained personnel in sufficient number to do the
information sciences job effectively. As soon
as individuals are trained, they are often
recruited for work in higher paying commercial
positions.

5. The institute will serve as a focal point
for U.S. leadership in information sciences.
Its research work could be unaffected by proprietory
motives and without inhibitions of trade secrecy.
It could represent the United States in inter-
national activities in the information field.
This would include phases of important projects
such as surveillance for disarmament, dissemina-
tion of technical data to newly developing
countries and interchange of technical information
on space activities.

6. As an independent research organization it
would not only work on immediate programs, but
also would plan and implement long range informa-
tion systems design efforts which are vital to
increasing the efficiency of our government
operations.

7. As a U.S. sponsored entity the institute would have access to classified data and would thus be available to military and intelligence segments of the government, both of which have critical needs for improved information systems.

8. In short, the maximum creativity of highly qualified persons would be brought to bear on the information problem without the deadening burden of official U.S. bureaucracy, academic diversion, or commercial constraints.

6. ACTION REQUIRED

The following actions are required next.

1. Prepare materials for a 30 minute briefing on the institute.

2. Prepare a more detailed project implementation plan.

3. Prepare annexes, budget, etc.

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